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SPECIFICATION FOR PORCELAIN GUY STRAIN INSULATORS

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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SPECIFICATION FOR PORCELAIN GUY STRAIN INSULATORS

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SPECIFICATION FOR PORCELAIN GUY STRAIN INSULATORS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 16 September 1969, after the draft finalized by the Electrical Insulators and Accessories Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard has been prepared with a view to limiting the number of sizes of the porcelain guy strain insulators.

0.3 In the preparation of this standard, assistance has been derived from ASA C29.4-1961 'Wet-process porcelain insulators (strain type)' issued by the United States of America Standards Institute.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard prescribes the requirements and tests for strain type porcelain guy insulators used in the transmission and distribution of electrical energy.

1.2 It does not cover insulators forming part of electrical apparatus or porcelain parts used in their construction.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Porcelain Guy Strain Insulator — An insulating porcelain element generally of elongated form with two transverse holes or slots used for the purpose of insulating a guy or a cable.

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*Rules for rounding off numerical values (*revised*).

2.2 Lot — All the insulators offered for acceptance which are of the same type and design and manufactured under similar conditions of production. A lot may consist of the whole or a part of the quantity ordered.

2.3 Creepage Distance — The shortest distance, following the contour along the external surface of the insulator, from the earthed end to the conductor end.

2.4 Dry or Wet Power-Frequency Flashover Voltage — The mean value of the measured power-frequency voltages which cause flashover of the insulator under conditions specified in **7.2** or **7.3**.

2.5 Dry or Wet Power-Frequency Withstand Voltage — The specified power-frequency voltage which the insulator shall withstand under the conditions specified in **7.2** or **7.3** for the specified time without flashover or puncture

2.6 Failing Load — The greatest mechanical load which can be applied to a guy insulator under conditions specified in **7.4**.

2.7 Type Tests — Tests carried out to prove conformity with the specification. These are intended to prove the general qualities and design of a given type of insulator.

2.8 Acceptance Tests — Tests carried out on samples taken from the lot for the purpose of acceptance of the lot.

2.9 Routine Tests — Tests carried out on each insulator to check requirements which are likely to vary during production.

3. REFERENCE ATMOSPHERIC CONDITIONS

3.1 Reference atmospheric conditions at which the electrical characteristics of the insulator shall be expressed for the purpose of comparison shall be as given below:

Ambient temperature	20°C
Barometric pressure	1 013 millibars
Absolute humidity	11 g of water per cubic metre corresponding to 63 percent relative humidity at 20°C

NOTE — The Indian Standard reference temperature of 27°C and corresponding humidity have not been specified because of the non-availability of the test voltage values and correction factors for these conditions. These conditions will replace those specified above when the corresponding test voltage values and correction factors are available.

3.2 Tests for the purposes of this standard shall preferably be carried out under conditions of temperature and humidity specified in IS: 196-1966* (that is, a temperature of 27° ± 2°C and relative humidity of 65 ± 2 percent) and at the prevailing atmospheric pressure. When this is not possible, test may be carried out under conditions naturally obtaining at the time of the test. The barometric pressure, air temperature and humidity shall be recorded for the purposes of corrections (*see* Appendix A).

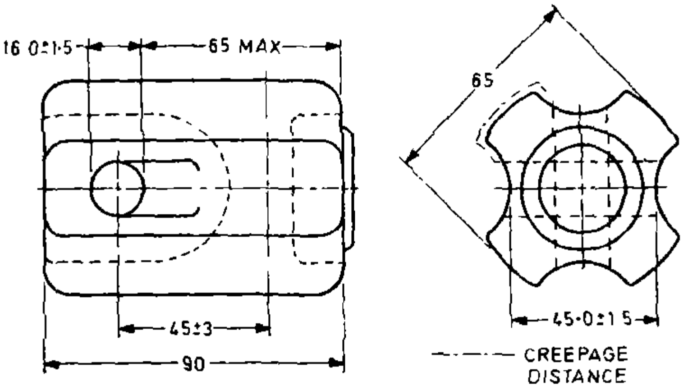
4. GENERAL REQUIREMENTS

4.1 The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed.

4.2 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to its deterioration.

4.3 The glaze, unless otherwise specified, shall be brown in colour. The glaze shall cover the entire porcelain surface parts except those areas that serve as supports during firing or are otherwise required to be left unglazed.

4.4 The dimensions of guy strain insulators essential from the point of view of interchangeability shall be in accordance with Fig. 1 to 3.



All dimensións in millimetres.

FIG. 1 GUY STRAIN INSULATOR, DESIGNATION A

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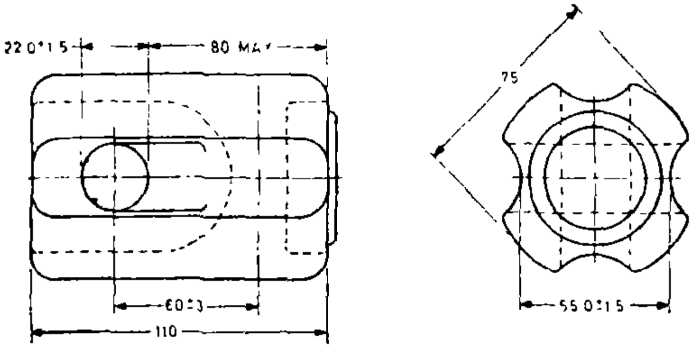
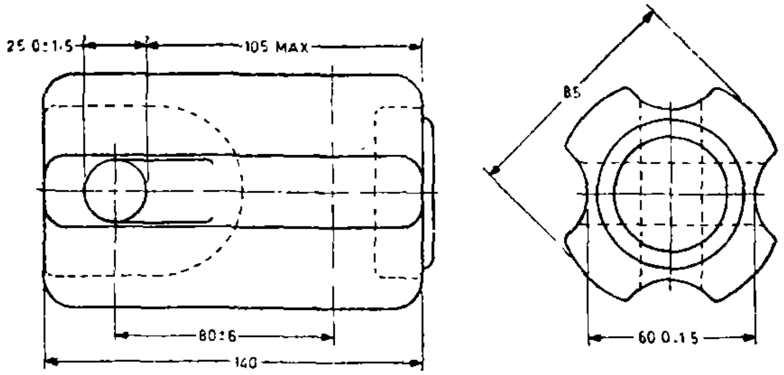
*Atmospheric conditions for testing (*revised*).



All dimensions in millimetres.

FIG. 2 GUY STRAIN INSULATOR DESIGNATION B



All dimensions in millimetres.

FIG. 3 GUY STRAIN INSULATOR DESIGNATION C

5. INSULATOR CHARACTERISTICS

5.1 The guy strain insulators shall have the electrical and mechanical characteristics given in Table 1.

TABLE 1 CHARACTERISTICS OF INSULATORS

(*Clause* 5.1)

DESIGNATION OF INSULATOR	LENGTH	DIAMETER	CABLE HOLE DIA	MINIMUM FAILING LOAD	CREEPAGE DISTANCE	DRY ONE-MINUTE POWER-FREQUENCY WITHSTAND VOLTAGE	WET ONE-MINUTE POWER-FREQUENCY WITHSTAND VOLTAGE	FIGURE REFERENCE
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	mm	mm	mm	N*	mm	kV (rms)	kV (rms)	
A	90	65	16	44 000	41	18	8	Fig. 1
B	*110*	*75*	*22*	*53 000*	*48*	*22*	*9*	*Fig. 2*
C	140	85	25	88 000	57	27	13	Fig. 3

*1 N = 0·101 972 kgf.

6. MARKING

6.1 Each insulator shall be legibly and indelibly marked to show the following:

a) Name or trade-mark of the manufacturer,

b) Year of manufacture, and

c) Country of manufacture.

6.1.1 Markings on porcelain shall be printed and shall be applied before firing.

6.2 Insulators may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. TESTS

7.1 General

7.1.1 *Type Tests* — The following shall constitute the type tests and these shall be conducted in the order given:

a) Visual examination (**7.8**),

b) Verification of dimensions (**7.5**),
c) Temperature cycle test (**7.6**),
d) Dry one-minute power-frequency withstand test (**7.2**),
e) Wet one-minute power-frequency withstand test (**7.3**),
f) Mechanical strength test (**7.4**), and
g) Porosity test (**7.7**).

7.1.1.1 The number of samples for type tests are to be agreed to between the purchaser and the supplier.

7.1.2 *Acceptance Tests* — The following shall constitute the acceptance tests and shall be conducted in the order given:

a) Verification of dimensions (**7.5**),
b) Temperature cycle test (**7.6**),
c) Mechanical strength test (**7.4**), and
d) Porosity test (**7.7**).

7.1.2.1 The number of insulators to be selected at random from the lot for these tests shall be in accordance with Table 2. If additional insulators are required, these shall also be selected at random.

TABLE 2 NUMBER OF INSULATORS TO BE SELECTED

LOT SIZE (1)	SAMPLE SIZE (2)
Up to 500	As agreed to between the purchaser and the supplier
501 ,, 800	12
801 ,, 3 200	16
3 201 ,, 8 000	18
8 001 and above	20

7.1.2.2 The samples selected in accordance with **7.1.2.1** shall be divided into two equal parts and subjected to tests as indicated below:

Test(s)	*Part(s) of Samples*
Verification of dimensions and temperature cycle test	Both parts
Mechanical strength test	First part
Porosity test	Second part

7.1.2.3 If more than one insulator fails to comply with any of the acceptance tests, the lot shall be rejected.

7.1.2.4 If one insulator fails to comply with any of the tests, a fresh quantity equal to twice the first quantity shall be subjected to retesting. The re-testing shall comprise the test in which the failure occurred preceded by those tests which may be considered to have influenced the results of the original tests. If no failure occurs in the re-test, thel ot shall be accepted.

7.1.3 *Routine Test* — Visual examination (**7.8**) of every insulator shall be carried out as routine test.

7.2 Dry One-Minute Power-Frequency Withstand Test

7.2.1 The insulator shall be tested under the conditions specified in Appendix B.

7.2.2 The value of the test voltage shall be as specified in Table 1 taking into account the atmospheric conditions (*see* Appendix A).

7.2.3 The test voltage shall be applied for one minute The insulator shall not flashover or puncture during the test.

7.2.4 When required, the dry power-frequency flashover voltage test on the insulator shall be conducted by raising the voltage gradually from about 75 percent of the dry one-minute withstand value to reach the flashover voltage in not less than 5 seconds. The dry flashover voltage shall be the arithmetic mean of 5 consecutive readings, and the values shall be recorded after correction to the reference atmospheric conditions (*see* Appendix A).

7.3 Wet One-Minute Power-Frequency Withstand Test

7.3.1 The insulator shall be tested under conditions specified in Appendix B.

7.3.2 Before the commencement of test, the insulator shall be exposed to the artificial rain produced in accordance with **3.3** of IS : 2071-1962*.

7.3.3 The value of the test voltage shall be as specified in Table 1 taking into account the atmospheric conditions (*see* Appendix A).

7.3.4 The test voltage shall be applied for one minute. The insulator shall not flashover or puncture during the test.

7.3.5 When required, wet power-frequency flashover voltage test on the insulator shall be conducted by raising the voltage gradually from about 75 percent of the wet one-minuute withstand value to reach the flashover voltage in not less than 5 seconds. The wet flashover voltage shall be the arithmetic mean of five consecutive readings, and the values shall be recorded after correction to the reference atmospheric conditions (*see* Appendix A).

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*Methods of high voltage testing. (Since revised).

7.4 Mechanical Strength Test

7.4.1 The mechanical test shall be carried out on the insulator in the manner prescribed in **7.4.2**. The load shall be started at zero and smoothly brought up in a practically stepless variation to the failure point. The load is to be increased rapidly to approximately 75 percent of rated strength and at a slower rate from this point to failure.

7.4.2 Mechanical load of pure compression shall be applied in line with the main axis of the specimen using standard guy wire or steel rope. The loop shall be suitably clamped so as to prevent slipping of the wire and the clamps shall be so positioned that the distance between the edge of the nearest clamp and the insulator is one insulator length. The diameter of rope shall not exceed 75 percent of the diameter of the hole of the insulator.

7.4.3 Breakage shall not occur at a load less than the minimum failing load given in Table 1.

7.5 Verification of Dimensions

7.5.1 The dimensions of guy strain insulator shall be in accordance with Fig. 1 to 3.

7.5.2 Unless otherwise specified, a tolerance of ±5 percent shall be allowed on all dimensions.

7.6 Temperature Cycle Test

7.6.1 The insulators shall be quickly and completely immersed in a water-bath maintained at a temperature of 70°C above that of the cold water contained in another bath and left submerged for a period of 15 minutes. They shall then be withdrawn, and quickly and completely immersed, without being placed in an intermediate container in the bath of cold water for the same period.

7.6.2 The complete test shall comprise five transfers, namely, hot to cold, cold to hot, hot to cold, cold to hot, and hot to cold. The time taken to transfer the insulators from one bath to the other shall be as short as possible, not exceeding 30 seconds. The quantity of water in each water-bath shall be large enough not to cause a temporary variation of more than 5 deg C in the water, when the insulators are immersed.

7.6.3 After the completion of the immersion, the insulator shall be examined to verify that the insulating parts have not cracked and the glaze is undamaged.

7.7 Porosity Test

7.7.1 Porcelain fragments from the insulators or, by agreement, from representative pieces of porcelain fired adjacent to them shall be immersed in one percent alcoholic solution of fuchsin (1 g of fuchsin in 100 g of methylated spirit) under a pressure not less than 150 kg/cm^2 for a period such that the product of test duration in hours and the pressure in kg/cm^2 is not less than 1 800.

7.7.2 The fragments shall then be removed from the solution, washed. dried and broken. The examination with naked eye of freshly broken surface shall not reveal any dye penetration. Penetration into small cracks formed during the initial breaking shall be neglected.

7.8 Visual Examination — A visual examination of the insulator shall be made. The insulator shall be free from physical distortion of shape and the vitrified glaze shall be hard, smooth and free from cracks or any other defect likely to be prejudicial to satisfactory performance in service.

APPENDIX A

(*Clauses* 3.2, 7.2.2, 7.2.4, 7.3.3 *and* 7.3.5)

CORRECTION OF TEST VOLTAGES FOR ATMOSPHERIC CONDITIONS

A-1. GENERAL

A-1.1 Variations in barometric pressure and humidity of the atmosphere cause variation in the electric strength of the air and hence also in the flashover voltage of insulators exposed to the air; under-oil flashover and puncture strength, however, are not significantly affected by these changes.

A-2. CORRECTION FACTORS

A-2.1 When the atmospheric conditions in the neighbourhood of the insulator during the test differ from the reference conditions, adjustments should be made to the test voltages by the application of the following correction factors in accordance with Table 3·

a) *Correction factor for air density* (*d*)

$$d = \frac{0{\cdot}289\,p}{273 + t} \quad (d \text{ lies between } 0{\cdot}95 \text{ and } 1{\cdot}05)$$

where

p = atmospheric pressure in millibars, and

t = temperature in degrees Celsius.

For a wider range of density and for higher accuracy, instead of *d* the factor *k* shall be used. The values of *k* corresponding to factor *d* are given below:

d	*k*
0·70	0·72
0·75	0·77
0·80	0·82
0·85	0·86
0·90	0·91
0·95	0·95
1·00	1·00
1·05	1·05
1·10	1·09
1·15	1·13

b) *Correction factor for humidity* (*h*) — Figure 4 gives the absolute humidity value for wet and dry bulb temperatures (when the velocity of air over the wet bulb exceeds 3 metres per second) for the standard atmospheric pressure of 1 013 millibars. For better accuracy, a correction should be applied to absolute humidity value obtained from Fig. 4 for any deviation of ambient atmospheric pressure from the standard value of 1 013 millibars. This correction should be obtained from Fig. 5 as follows:

> Locate the point corresponding to the deviation of ambient atmospheric pressure from 1 013 millibars on the left hand side of Fig. 5B and join it with right hand side top corner by a straight line. Then locate the point on the curve in Fig. 5A corresponding to the observed value of the difference of dry and wet bulb temperature. Draw a vertical line through this point to intersect the straight line drawn in Fig. 5B. Read the correction to be applied to humidity from the right hand side of Fig. 5B corresponding to the point of intersection. This correction is positive for a positive deviation and negative for negative deviation from the standard atmospheric pressure.

For the corrected value of absolute humidity thus obtained, the correction factor *h* of Table 3 shall be determined from Fig. 6.

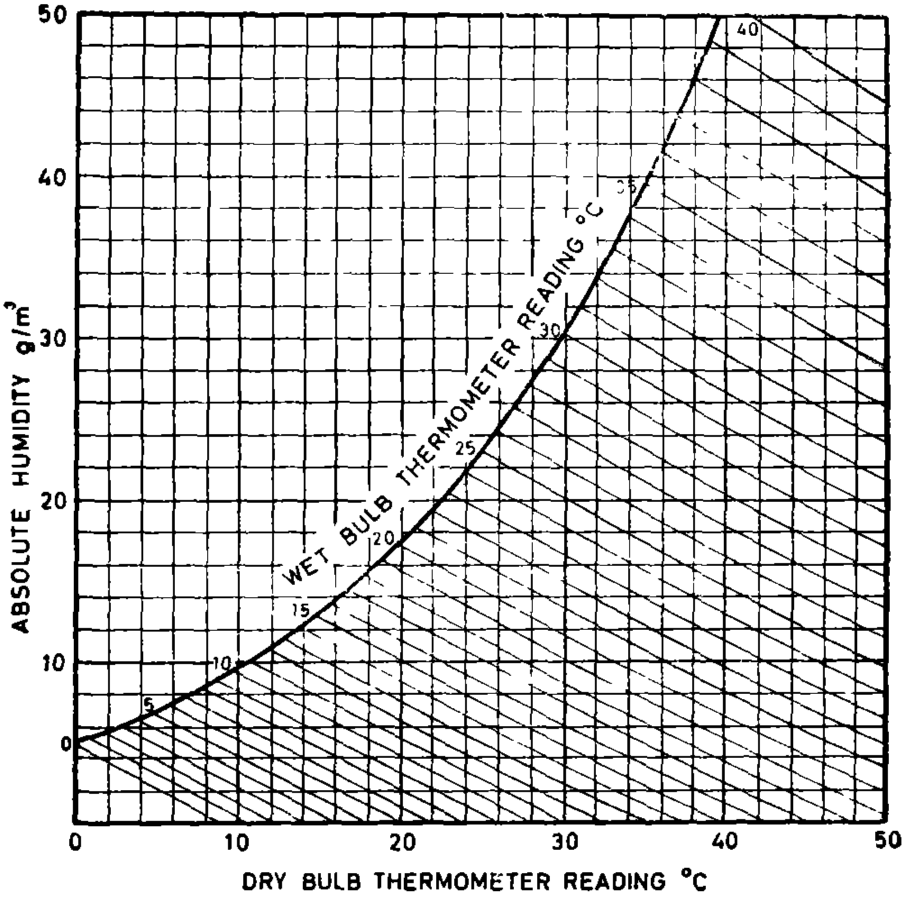

FIG. 4 DETERMINATION OF ABSOLUTE HUMIDITY

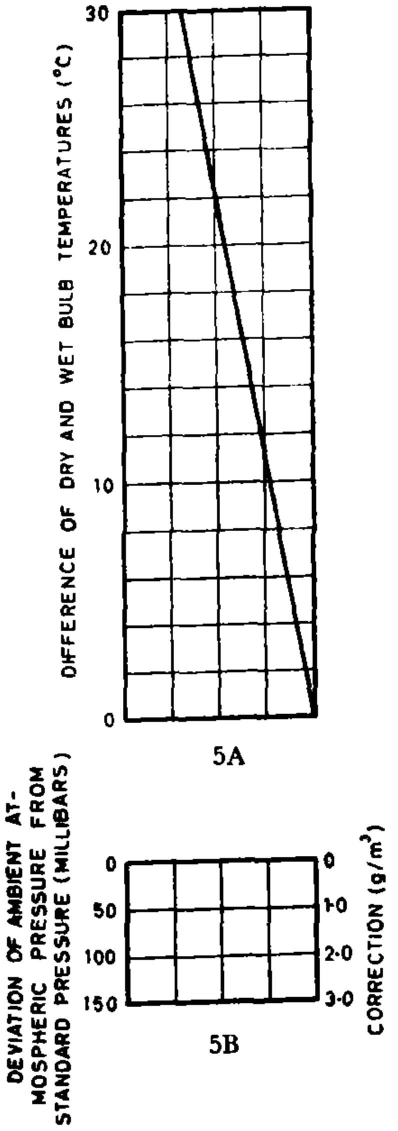

FIG. 5 CORRECTION TO ABSOLUTE HUMIDITY FOR VARIATION IN PRESSURE

TABLE 3 CORRECTION OF VOLTAGES FOR ATMOSPHERIC CONDITIONS

(*Clause* A-2.1)

TEST	ADJUSTMENT REQUIRED
Dry one-minute power-frequency withstand test	Voltage applied shall be the appropriate value specified in Table 1 multiplied by *k* and divided by *h*
Dry power-frequency flashover test	Measured voltage shall be divided by *k* and multiplied by *h*
Wet one-minute power-frequency withstand test	Voltage applied shall be the appropriate value specified in Table 1 multiplied by *k*
Wet power-frequency flashover test	Measured voltage shall be divided by *k*

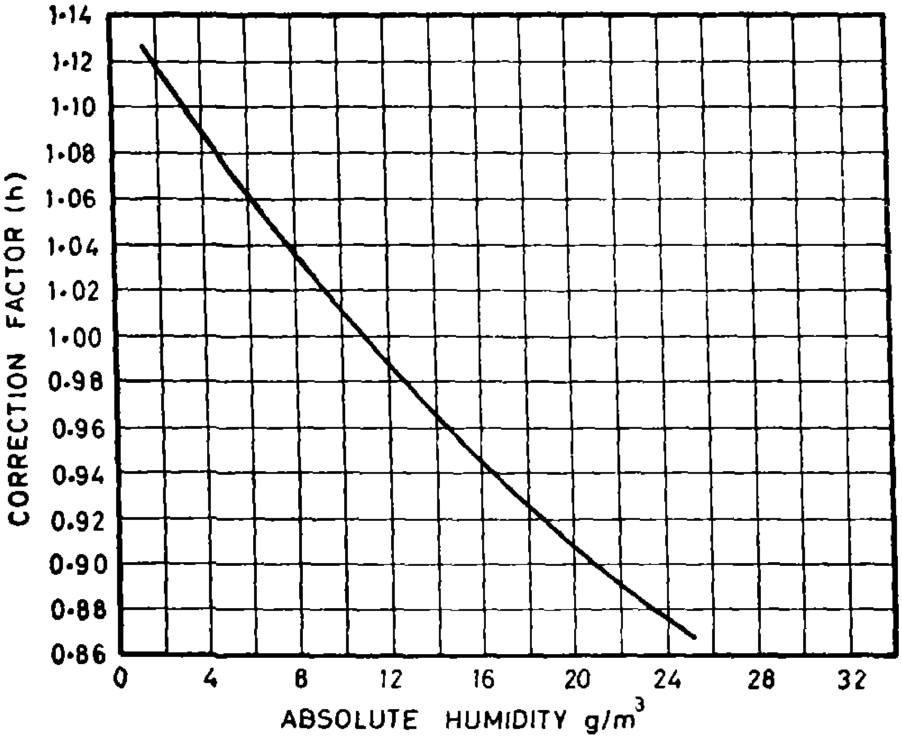

FIG. 6 HUMIDITY CORRECTION FACTOR

APPENDIX B

(*Clauses* 7.2.1 *and* 7.3.1)

CONDITIONS FOR POWER-FREQUENCY TESTS

B-1. ARRANGEMENT OF INSULATOR

B-1.1 The insulator shall be clean and dry and in thermal equilibrium with its surroundings.

B-1.2 The insulator shall be mounted in a position with its major axis at 45° from the vertical (for wet one-minute power-frequency withstand test, the major axis shall be at right angles to the spray direction, and the axis of the upper conductor hole or slot shall be horizontal), using flexible metal conductors of diameter approximately 50 percent of the hole diameter. The conductor shall be clamped with guy clamps, spaced from the test specimen at a distance not less than the test specimen length. Mechanical tension sufficient to avoid appreciable sag in the set up shall be applied to the test specimen. The lower conductor shall be grounded.

B-1.3 During the test, no object other than the parts of the test assembly shall be nearer the test specimen than 0·5 metre or 1·5 times the length of the insulator, whichever is greater.

B-2. TESTS

B-2.1 The power-frequency tests shall be made in accordance with IS:2071-1962*.

B-2.1.1 The transformer test circuit shall be such that when the test object is short-circuited at the test voltage, the current is not less than 0·1 A if dry tests are made and not less than 0·5 A if wet tests are to be made.

B-3. EXCESSIVE HUMIDITY

B-3.1 Precautions shall be taken to avoid formation of dew on the surface of the insulator especially when the relative humidity is high (above 85 percent). For example, the insulator shall be maintained at the ambient temperature of the test location for sufficient time for equilibrium to be reached before the test commences.

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*Methods of high voltage testing. (*Since revised*).

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